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# CURRENT ACTIVITIES

## ATLANTIC PROVINCES

***Deterioration of Fire-Killed Balsam Fir and Spruce Stands in Newfoundland and New Brunswick.***—In 1947, Skolko (For. Chron. 23: 128-145, 1947) reported that sap-rot losses in moderately severely and severely burned pulpwood stands were of little importance at least for the first five years following death. Recent studies and observations in Newfoundland and New Brunswick confirm the minor importance of sap rots in standing fire-killed balsam fir and spruce.

The analysis of 25 standing trees (averaging 6.1 inches D.B.H.) in a 4-year-old burn in Newfoundland showed that a firm reddish-brown sap rot had penetrated to an average depth of 0.3 inches into the outer sapwood. Small patches of unfirm sap rot were found at the butt of a few trees but did not extend more than 4 feet from ground level. Since the trees were extremely dry and almost completely free of bark, the future progress of decay would probably be very slow. To verify this assumption old burned-over areas were visited in New Brunswick and standing trees were examined for decay. In one 12-year-old burn, 25 trees (averaging 4.8 inches D.B.H.) were found to contain an average of only 0.2 inches of firm sap rot in the outer sapwood. Small scale salvage operations had been conducted profitably in this area two years previously (ten years after the fire). Similar salvage operations are reported to have been carried out in an 18-year-old burn, predominantly spruce, in Newfoundland.

On the basis of these observations, balsam fir and spruce in moderately severely and severely burned areas might be salvaged almost indefinitely if the trees remain standing—M. A. Stillwell.

## QUEBEC

***Observations on a New Poplar Leaf Miner, Phytagromyza populicola (Hal.).***—Larvae of this fly were noted for the first time in August 1956, mining the leaves of Lombardy poplars in Quebec City. From the material reared in the laboratory, a few adults emerged which were sent to the Systematic Entomology and Biological Control Unit in Ottawa. According to information obtained, this species is of European origin and this is the first record of its presence in North America. In 1957, the insect was found almost everywhere in the southeastern part of the Province of Quebec. Its preferred host tree seems to be the Lombardy poplar, *Populus nigra* L., but it was also found on *P. deltoides* L., *P. tremuloides* Michx., and *P. grandidentata* Michx.

During the last season, a few interesting observations were made on the behaviour of this insect. Examination of a large number of affected leaves showed that eggs are usually inserted near the midrib and more rarely on the edge of the leaf. The larva excavates a blotch mine, working always on the upper surface of the leaf, eating away the parenchymatous tissue up to the palissade cells. The larva passes through three instars before it reaches its complete development and the mine gradually increases in size with the age of the insect. The first instar larval skin is always found not more than 1 mm. away from the egg, and the second between 5 and 8 mm. from it. At the end of larval development, the mine measures about 1 sq. cm. in area. The frass is disposed of without any set pattern, in the mine. When the latter is opened, it is noticeable that frass adheres to the upper surface. Most of the time the mine looks just like a blotch without any definite prolongation. An elongated mine sometimes follows a major vein or the margin of the leaf, but very seldom crosses the midrib. When full development is reached, the larva cuts a semicircular slit on the upper surface of the leaf and transforms into a puparium either at the surface of the mine or on the surface of the leaf.

The first mines were noted in the field early in August. Their number increased until mid-September and active larvae persisted until the foliage dropped to the ground, early in October.

Two species of ectoparasites, *Pnignalio maculipes* (Cwfd.) and *Solenotus begini* (Ashm.), were reared from the larvae. Up to 50 per cent parasitism was encountered in some cases.

In 1957, an attempt was made to evaluate the population per tree. Ten Lombardy poplars about 25 feet high were selected and samples of leaves were removed at various levels of the crown with a pole pruner. The average number of mines varied with the sizes of the leaves, being 1.6 for smaller leaves, 2.7 for leaves of moderate size, and 3.6 for the larger ones. Results showed also that there is a significant difference in population density at different crown levels, decreasing from the lower to the upper crown. At a given level, the number of mines decreases from the inner to the outer crown. R. Béique and P. Bouchard.

## ONTARIO

***Further Observations on the Action of Bacillus sotto Toxin.***—It has been reported previously that silkworm larvae (*Bombyx mori* L.) infected with the bacterial pathogen *Bacillus sotto* become completely paralysed in little more than 60 minutes after ingesting the micro-organism. It has also been shown that the paralysis, which is irreversible and leads to death, is preceded by a significant alteration in the pH of the blood. The shift is to the alkaline side and amounts to 1.4 pH units in 60-70 minutes. Some of the disease symptoms can be produced by artificially increasing the blood pH with injections of suitable buffers.

The tomato and tobacco hornworms also are susceptible to the action of *B. sotto* but we have found that these larvae do not become completely paralysed until 5 or 6 hours after ingesting the bacteria. As in silkworm there is a progressive change in blood pH to the alkaline side. When paralysis occurs the change amounts to 1.1 pH units.

Both the silkworm and the hornworm larvae have strongly alkaline midgut contents suggesting that there may be a correlation between susceptibility and gut contents alkalinity. However a large number of Canadian Lepidoptera are killed by *B. sotto* (and related crystallophorous spore-formers) in spite of the fact that their midgut contents are only moderately alkaline. We have been studying the susceptibility and responses of some of these species to the action of *B. sotto*.

Larvae of a number of species (see table) were placed on sprigs of the appropriate foliage in lantern globe rearing sets. Test foliage was coated with varying amounts of washed cells of *B. sotto*; control foliage was uncoated. The behaviour of the insects was observed and recorded until death. At 6-hour intervals a number of larvae were removed and the pH of their blood was determined.

When larvae of *Anisota senatoria* were placed on foliage coated with *B. sotto*, a small primary meal was taken in the first 2 hours. After this there was no subsequent feeding. The decrease in feeding activity was paralleled by a decrease in frass drop. Unlike hornworm and silkworm there was no rapid general paralysis. The larvae became sluggish, and death occurred anytime between 24 and 96 hours with the peak of mortality usually before 72 hours. This behaviour was typical for most of the insects named in the accompanying table. Larvae reared on uncoated foliage fed and developed normally.

When the blood of infected larvae was examined we observed no shift to the alkaline side as with the silkworm and hornworm. The changes observed (± 0.4 pH units) are given in the table; they are not significantly different from the variation observed in normal insects. In these species with moderately alkaline midgut contents, general paralysis does not precede death as it does in hornworm and

silkworm which have highly alkaline midgut contents. Lepidopterous larvae as a group usually have blood which is slightly acid and midgut contents which are alkaline. There is therefore a gradient between the pH of the blood and midgut contents. Where the gradient is steep, as in silkworm and hornworm, rapid generalized paralysis occurs. Where the gradient is less steep, as in the other species tested, there is no general paralysis. There is evidence however that gut paralysis does occur and this is reflected in the cessation of feeding and frass drop. These observations will be reported on in detail elsewhere.—T. A. Angus and A. M. Heimpel.

Blood pH Changes in Diseased Lepidopterous Larvae

| — | pH of Blood (range) | |
|---|---|---|
| | Normal | Diseased |
| *Malacosoma disstria* | 6.65—6.79 | 6.60—6.69 |
| *Malacosoma pluviale* | 6.52—6.58 | 6.20—6.80 |
| *Malacosoma americanum* | 6.39—6.52 | 6.25—6.40 |
| *Hyphantria cunea* | 6.46—6.60 | 6.46—6.60 |
| *Schizura concinna* | 6.29—6.35 | 6.20—6.60 |
| *Anisota senatoria* | 6.49—6.54 | 6.49—6.54 |
| *Anisota rubicunda* | 6.45—6.56 | 6.40—6.70 |
| *Lambdina fiscellaria fiscellaria* | 5.37—6.35 | 5.3 —6.3 |
| *Halisidota caryae* | 6.52—6.60 | 6.5 —6.6 |
| *Actebia fennica* | 6.10—6.70 | 6.5 —6.7 |
| *Nymphalis antiopa* | 6.50—6.70 | 6.3 —6.8 |
| *Datana ministra* | 6.37—6.46 | 6.4 —6.5 |
| *Bombyx mori* | 6.70—6.83 | 7.7 —8.1 |
| *Protoparce quinquemaculata* | 6.42—6.6 | 7.4 —7.57 |

***Heartwood Decay and Needle Blight of White Pine.***—White pine needle blight, a disease of unknown origin, has been under investigation intermittently since the turn of the century. At different times, it had been speculated that microorganisms were directly or indirectly involved, but no positive findings have been recorded.

In the summers of 1955 and 1957 at the Petawawa Forest Experiment Station, Chalk River, Ontario, investigations were conducted on the water economy of both needle-blighted and healthy white pines in the 50- to 80-year age class. In these studies the trees were felled and dissected at frequent intervals from ground level to tree top in order to trace the movements of injected coloured chemical solutions and also to ascertain the content and distribution of moisture in their various parts. At the same time, it was possible to examine the exposed heartwood for the presence of decay, and so determine if there was any relationship between heart rot and needle blight in white pine.

Needle blight symptoms may appear or disappear on the foliage of some trees in different years, a situation which engenders doubt that these trees are truly affected by the disease. However, the diseased trees selected for the study of the movement and storage of water were those which exhibited needle blight symptoms on their foliage of the current year for several years in succession and thus may be definitely classified as being "needle-blighted". Definition of the occurrence of needle blight was obtained from survey data accumulated in this area since 1948 by Mr. B. W. Dance. Neighbouring trees, comparable in size to the diseased trees, but never observed with needle blight symptoms during the same period of years, were selected as controls. A total of 44 white pines were examined, of which half were needle-blighted and the remainder were healthy.

The following table records the presence or absence of heartwood decay in the 44 trees.

| Heartwood condition | Trees with a known history of needle blight | | Trees never observed to exhibit needle blight symptoms | |
|---|---|---|---|---|
| | number | percentage | number | percentage |
| No decay | 16 | 72.7 | 19 | 86.4 |
| Decay in butt | 5 | 22.7 | 2 | 9.1 |
| Decay in trunk | 1 | 4.5 | 1 | 4.5 |

More needle-blighted trees than healthy trees possessed decay in their butts. None of these trees showed evidence of wounds or fire scars on their butts, and it is possible that the butt rots originated in the roots. It has been reported that needle-blighted trees possess a greater number of dead roots than healthy trees. (Faull, J. H. "Needle blight" of white pine. Report of the Department of Lands and Forests and Mines, Ontario 1919-20). Whether or not these dead roots were caused by root-rotting fungi, by an unfavourable environment, or were a result of needle blight, is highly conjectural.

A very large percentage of both the healthy and diseased trees displayed no evidence of decay either in butt or trunk. The percentage of diseased trees affected by decay was lower than the averages obtained by White for the same age group of white pine from a wide range of growing conditions (White, L.T., Decay of white pine in the Timagami Lake and Ottawa Valley areas. Can. J. Bot. 31: 175-200, 1953). It is concluded that there is no relationship between heartwood decay in the commercial portions of the stem and white pine needle blight.—S. N. Linzon.

***A Note on Exoteleia dodecella L.***—A recent survey has shown that *Exoteleia dodecella* L., a European pine bud moth, is common throughout most of eastern and southern Ontario, as far north as Ottawa in the east and Owen Sound in the west. This insect was first reported in North America in 1928 when it was found in the Niagara Peninsula. It attacks the buds of pines in early spring, and in some cases 60 per cent mortality of buds has been recorded. The result of severe attack is an extremely crooked and bunchy type of growth.

The larvae and the damage are superficially similar to those of the European Pine Shoot Moth, and there is no doubt that the two species have been confused in the past. Mixed infestations are common, and careful scrutiny is necessary to determine the extent to which each species is responsible.

The preferred hosts of *E. dodecella* are Scots pine and Mugho pine, but Austrian, red, white, and jack pines are attacked when they are growing close to heavy infestations in the two former trees.—J. L. Martin.

## ROCKY MOUNTAIN REGION

***Fungi Associated with Living and Dead Branches of Pole-sized Aspen.***—In 1957 preliminary studies were made on pole-sized aspen in the Lesser Slave Lake Region of Alberta to determine the fungi and factors influencing early decay infections in this species. Two dead and nine living aspen ranging from 20 to 28 years of age and growing on a site of intermediate quality were sampled for the occurrence of fungi in the embedded trunk portion of living and dead branches. Three classes of dead branches were sampled, namely, intact branches, protruding stubs, and buried stubs. Isolations were made from the heartwood of the embedded portion of the branch, the pith region at the base of the branch, and from the region of tension wood above the embedded portion of the branch

Several species of fungi and bacteria were isolated from the heartwood and dead branches and from the adjacent pith region of the stems, but rarely were any obtained from either the region of tension wood above the axes of the branches or from the embedded portion of living branches. Of 52 living branches sampled, only 1 yielded a fungus. The results of isolations from the various classes of dead branches sampled in living trees are shown in the accompanying table.

| — | Intact Branches | Protruding Stubs | Buried Stubs | Total | Percentage |
|---|---|---|---|---|---|
| No. sampled | 53 | 78 | 22 | 153 | |
| No. yielding cultures | 13 | 36 | 8 | 57 | |
| Percentage yielding cultures | 24.5 | 46.2 | 31.8 | ........ | 37.2 |
| Organisms isolated: | | | | | |
| *Cytospora chrysosperma* (Pers.) Fr. | 5 | 13 | 5 | 23 | 40.4 |
| *Phoma* sp. | 2 | 4 | 0 | 6 | 10.5 |
| *Libertella* sp. | 1 | 1 | 1 | 3 | 5.3 |
| *Corticium polygonium* Pers. | 1 | 5 | 0 | 6 | 10.5 |
| Unknown No. 9 | 0 | 3 | 0 | 3 | 5.3 |
| *Fomes igniarius* var. *populinus* (Neum.) Campbell | 0 | 0 | 2 | 2 | 3.5 |
| Bacteria | 0 | 4 | 0 | 4 | 7.0 |
| Miscellaneous | 4 | 6 | 0 | 10 | 17.5 |
| Totals | 13 | 36 | 8 | 57 | |

An unidentified fungus which stained agar black and was designated as Unknown No. 9 accounted for 5.3 per cent of the total number of infections. Approximately 18 per cent of the infected samples were associated with miscellaneous

fungi, some of which were obviously contaminants obtained during culturing. The single culture obtained from a living branch was included with the miscellaneous group of fungi and possibly represents an air contaminant.

The larger number of infections occurring in the heartwood of broken branches than in the corresponding region of intact dead branches suggests that the physical condition of the wood, for instance, moisture content, may be decisive in determining when infection takes place. There is also evidence that the condition and age of the branch determines which species of fungi may enter the succession. In the table it is interesting to note that *Libertella* sp., *Phoma* sp., and *Cytospora chrysosperma* are among the pioneer organisms which colonize intact branches soon after their death. The occurrence of Unknown No. 9 and *C. polygonium* and perhaps some species of bacteria mainly in broken branches might indicate that the presence of exposed heartwood or drier conditions are necessary for the sucessful invasion of the stem by these organisms. *Fomes igniarius* var. *populinus* appears to be relatively late in entering the fungal succession since only branches which had recently healed over yielded this fungus.

A similar association of fungi was found in the two dead trees, except for the absence of *C. polygonium* and *F. igniarius* var. *populinus*. An investigation of the moisture content of the heartwood revealed that the imperfect fungi occurred in wood having a moisture content in the range 21 to 130 per cent of the oven dry weight. But the two wood-destroying fungi were confined to wood having a moisture content ranging from 50 to 120 per cent with 70 per cent of the infections by these two fungi occurring in wood having a moisture content of from 80 to 100 per cent. The dead trees possessed a moisture gradient ranging from 85 per cent at the butt to 16 per cent at the top, whereas the gradient in the living trees ranged from 73 per cent at the butt to 137 per cent at top. The lack of adequate moisture in the dead trees might therefore explain the absence of wood-destroying fungi in these trees.

The two wood-destroying fungi and two of the imperfect fungi occur also on mature aspen in Alberta. The two wood-destroying fungi undoubtedly are among the most important organisms causing decay in older trees; thus, it is significant that their presence has been observed at such an early age. The two imperfect fungi, *C. chrysosperma* and *Libertella* sp. are also associated with decay in mature aspen but their importance in the heartrot problem has yet to be determined. Although the former is well known as a normal inhabitant of the bark of poplar, becoming parasitic and producing cankers if the host is weakened, this appears to be the first record of its presence in the heartwood as a saprophyte. *Libertella* predominated among the isolates obtained from both sound and decayed wood and in this respect its association with decay appears similar to that of *Coryne sarcoides* (Jacq.) Tul. with heartrot in conifers. As reported for *C. sarcoides*, this fungus does not appear to be capable of causing decay under laboratory conditions and therefore its status as a decay pathogen is not altogether certain.—D. E. Etheridge and J. Laut.

## BRITISH COLUMBIA

***Winter Injury and Subsequent Mortality to Douglas Fir.***—Considerable damage and mortality occurred in stands of Douglas fir in the Cariboo region following unusually great temperature differences during the winter months of 1951 and 1952. While there were no reports of widespread damage in 1952, many thousands of acres of Douglas firs between the Fraser River and Horsefly Lake were reported in 1953 to be in various stages of decline. Parts of the affected area were examined in 1955 by forest entomologists who reported Douglas-fir beetle activity of outbreak proportions. Since only a few of the trees examined in 1955 had been infested before 1953, it was concluded that the increased beetle population of 1955 was a reflection of 1952-53 winter injury (J. Walters, Bi-Mon. Prog. Rept. 11(4). 1955).

By 1956 many of the damaged trees had recovered to the extent that they had regained a normal complement of foliage. On the other hand, sufficient trees had died in some localities to warrant observations being made on the nature and rate of deterioration of killed Douglas fir. A study was begun for this purpose in 1956 and is continuing. In the course of this study it was possible to determine the year of death of individual trees and therefore to establish the sequence of mortality following winter injury. The techniques used to ascribe a year of death to individual trees were those described by Ghent (For. Chron. 28(4). 1952). Prior to their use in the present study, however, these techniques were tested in the region concerned for their application to dead Douglas fir.

One hundred dead Douglas firs within the area of suspected winter injury were examined during 1956 and 1957. Although 7 of these trees had died before 1952, none had died in 1950 and 1951. The death of 15 trees following the 1952 growth period, but prior to the 1953 growth period, together with the death of even a larger number of trees in subsequent years, substantiates the fact of severe injury having occurred sometime during the 1952-53 winter. The trend of mortality following this injury is shown in Table I, which also shows the condition of dead trees in regard to Douglas-fir beetle activity. Since 10 of the dead trees showed no signs of beetle attack and 7 others had sustained only light attacks, some trees were apparently killed outright by frost despite the rapidity with which Douglas-fir beetles attack weakened trees. Thus, at least 18 per cent of the trees sampled had probably died directly as the result of winter injury.

TABLE I

RELATION OF DOUGLAS-FIR BEETLES TO MORTALITY FOLLOWING WINTER INJURY TO DOUGLAS FIR

| Year of death | Number of dead trees | | | |
|---|---|---|---|---|
| | Free from beetles | Beetle infested[1] | | Total |
| | | Light | Heavy | |
| 1952 | 4 | 1 | 10 | 15 |
| 1953 | 6 | 6 | 48 | 60 |
| 1954 | — | — | 16 | 16 |
| 1955 | — | — | 1 | 1 |
| 1956 | — | — | 1 | 1 |
| Total | 10 | 7 | 76 | 93 |

[1] Based on the number of galleries per square foot anywhere on the trunks of trees, namely, *Light* = less than 4 and *Heavy* = 4 or more.

TABLE II

THE EFFECT OF CROWN POSITION ON WINTER INJURY AND SUBSEQUENT MORTALITY TO DOUGLAS FIR

| Crown class | Number of trees | Condition class | | |
|---|---|---|---|---|
| | | Un-damaged | Damaged | Dead |
| | | | Per cent | |
| Dominant and codominant | 142 | 30 | 10 | 60 |
| Intermediate | 117 | 41 | 39 | 20 |
| Overtopped | 77 | 60 | 35 | 5 |
| Total | 336 | 40 | 26 | 34 |

Mortality in Douglas fir, whether the result of direct killing by frost or the killing of frost-injured trees by Douglas-fir beetles, occurred in a relatively consistent pattern throughout the damaged area. This pattern is indicated in Table II, which gives the results of a complete tally of Douglas firs made in 1956 on 5 acres of heavily damaged timber near Lac la Hache. While the degree of damage demonstrated by this sample approximates the maximum level of mortality for the region, the relative susceptibilities of trees of different crown classes is considered to be consistent with that sustained in other parts of the region. Thus, dominant and codominant trees appear to be much more susceptible to winter injury and subsequent killing than are intermediate and overtopped trees.—G. P. Thomas and H. M. Craig.

***A Technique for Measuring Flight Muscle Changes in the Douglas-fir Beetle, Dendroctonus pseudotsugae.***—Degeneration of flight muscles has been known to occur in ant and termite queens for many years and has been reported more recently in Diptera, Hemiptera, water beetles, and bark beetles. In recent studies on the flight response and capacity of the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk., flight muscle changes have been noted similar to those described by Chapman (Nature 177: 1183, 1956) for the ambrosia beetle, *Trypodendron lineatum* (Oliv.).

The following technique has been used successfully to determine quantitatively the extent of flight muscle changes at various periods of the life of this beetle.

The beetles were killed and fixed in Duboscq-Brasil (Alcoholic Bouin's) modified by the addition of 5 per cent glycerine and 0.4 per cent Fisher "Aerosol". The head, elytra, membranous wings, and tip of the abdomen were removed to allow better fixation, dehydration, and infiltration. To improve infiltration of the tissue with the wax ("Tissuemat") the beetles were subjected to reduced pressures of 15 to 25 lb. during this process.

From the fixative the material was placed in 80 per cent ethyl alcohol and dehydrated with isobutyl alcohol containing 5 per cent glycerine. The first step in infiltration was carried out at 52-54°C. in a vacuum of 15 lb. with 1:1

isobutyl alcohol and Fisher "Tissuemat". Further infiltration was carried out at the same temperature in a vacuum of 25 lb. with "Tissuemat" containing 5 per cent oleic acid and 5 per cent lanolin.

The glycerine, lanolin and oleic acid were used in an attempt to prevent excessive hardening of the tissues by heat and the dehydrating agents.

Frontal serial sections 20 microns thick were cut and those containing flight muscle were attached to glass slides in the usual manner. The sections were stained with Harris Haematoxylin, counterstained with 0.5 per cent Eosin Y in 95 per cent alcohol, and mounted in Permount.

The slides obtained were studied with a stereoscopic microscope and measurements made with an ocular micrometer. The widths of the muscle bundles are easily obtained by direct measurement: the length is also obtained by direct measurement and by reconstruction in cases of distortion. The thickness of the bundles is determined by counting the number of sections in which the muscle occurs at certain positions such as the points of attachment, and multiplying by the thickness of the sections.

In addition to supplying a quantitative picture of the muscle degeneration and regeneration, the sections are useful in illustrating the muscle distortion which occurs owing to the intrusion of the fully developed ovaries into the thorax and to the expansion of the ventriculus during feeding. Changes in the amount of fat body are also easily observed. Different intensities of staining of the various types of tissue at different times may be useful in supplying additional information about other changes which occur within the beetles throughout their adult life.—M. D. Atkins and S. H. Farris.

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